PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of	Docket No: Q66584
Masayuki NAYA, et al.	
Appln. No.: 10/053,585	Group Art Unit: 1641
Confirmation No.: 3468	Examiner: Christopher L. Chin
Filed: January 24, 2002	

For: SURFACE PLASMON RESONANCE MEASURING CHIP AND METHOD OF MANUFACTURE THEREOF

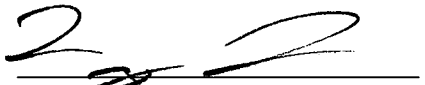
SUBMISSION OF APPEAL BRIEF

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith please find an Appeal Brief. The statutory fee of **$510.00** is being charged to Deposit Account No. 19-4880 via EFS Payment Screen. The USPTO is also directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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Date: August 19, 2008

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For: SURFACE PLASMON RESONANCE MEASURING CHIP AND METHOD OF MANUFACTURE THEREOF

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 41.37, Appellant submits the following:

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I. REAL PARTY IN INTEREST

The real parties in interest in this appeal is FUJI PHOTO FILM CO., LTD. and FUJI PHOTO OPTICAL CO., LTD., both of Japan. The assignment was previously submitted and was recorded on May 31, 2002, at Reel 012944, Frame 0252. It is noted that FUJI PHOTO OPTICAL CO., LTD. recorded a name and assignment change on March 18, 2005. The name of this assignee is now FUJINON CORPORATION, as recorded at Reel 016378, Frame 0184. It is also noted that FUJI PHOTO FILM CO., LTD. recorded a name and assignment change on February 15, 2007. The name of this assignee is now FUJIFILM CORPORATION, as recorded at Reel 018904, Frame 0001.

II. RELATED APPEALS AND INTERFERENCES

To the knowledge and belief of Appellant, the Assignee, and the Appellant's legal representative, there are no other appeals or interferences before the Board of Appeals and Interferences that will directly affect or be affected by the Board's decision in the instant Appeal.

III. STATUS OF CLAIMS

Claim 13 is canceled.

Claims 1-12 and 14-25 are pending in the present application. Claims 1-12, 14-18 and 22-25 stand finally rejected. The rejections of claims 1-12, 14-18 and 22-25 are being appealed.

Claims 1-6 and 14-18 have been rejected on the ground of nonstatutory obviousness-type double patenting, as allegedly being unpatentable over claim 13 of Kubo et al. (U.S. Patent No. 6,597,456) in view of Natsuume et al. (A New High Heat Resistant, High Clarity, And High Humidity Resistant Polymer For Optical Uses, **Materials Research Society Symposium Proceedings**, Materials Research Society, Pittsburg, PA, U.S. vol. 150, April 25, 1989, pages 245-250, XP009007850).

Claims 1-3 have been rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by Naya et al. (U.S. Patent No. 6,611,367).

Claims 4-6 and 22-25 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Naya in view of Natsuume.

Claims 1-12, 15-18 and 22-25 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Malmqvist et al. (U.S. Patent No. 5,492,840) in view of Natsuume.

Claims 19-21 are objected to for depending on rejected base claims but describe allowable subject matter.

A copy of the claims on appeal is set forth in an attached Appendix.

IV. STATUS OF AMENDMENTS

The Amendment filed on August 10, 2007 included claim modifications adding claims 22-25. The amendments and arguments for patentability are believed to have been entered and made of record.

The recitation of the claims is set forth in the attached Appendix.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

Description of the Independent Claim

The claims on appeal are explained as set forth below in reference to an exemplary embodiment. The claims should not be limited to the embodiments disclosed.

1. A surface plasmon resonance measuring chip (FIG. 1, element 10) for use in a surface plasmon resonance measurement apparatus (FIG. 1) constituted of a light source (FIG. 1, element 31) for emitting a light beam (FIG. 1, element 30); an optical system for making said light beam enter a dielectric block at various angles of incidence so that a condition for total internal reflection is satisfied at an interface between said dielectric block and said metal film (page 23, line 22 to page 24, line 4); and photodetection means (FIG. 1, element 40) for detecting the intensity of said light beam satisfying total internal reflection at said interface to detect surface plasmon resonance (page 26, line 16 to page 27, line 2); comprising:

a dielectric block (FIG. 2, element 11);

a metal film (FIG. 2, element 12), formed on a surface of said dielectric block (page 22, lines 10-11), for placing a sample thereon (page 22, lines 12-14);

wherein said dielectric block is formed as a single block that includes an entrance surface which said light beam enters, an exit surface from which said light beam emerges, and a surface on which said metal film is formed (page 22, lines 14-19);

said metal film is united with said dielectric block (page 8, lines 13-14 and page 28, lines 10-13); and

said dielectric block is formed from a synthetic resin (page 22, lines 21-24) in which, when said light beam is p-polarized outside said dielectric block and then strikes said interface, the intensity of an s-polarized component at said interface is 50% or less of the intensity of said light beam at said interface (page 8, lines 14-22, page 12, lines 4-8 and page 14, lines 19 to page 15, line 10).

Description of dependent claims argued separately:

2. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said dielectric block is formed from a synthetic resin in which, when said light beam is p-polarized outside said dielectric block and then strikes said interface, the intensity of a s-polarized component at said interface is 30% or less of the intensity of said light beam at said interface (page 8, line 23 to page 9, line 2 and page 15, line 11 to page 16, line 1).

3. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said dielectric block is formed from a synthetic resin in which, when said light beam is p-polarized outside said dielectric block and then strikes said interface, the intensity of a s-polarized component at said interface is 10% or less of the intensity of said light beam at said interface (page 9, lines 2-4 and page 16, lines 2-18).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

This appeal is directed to each prior art rejection. In particular, the grounds of rejection to be reviewed include those rejections wherein:

Claims 1-6 and 14-18 have been rejected on the ground of nonstatutory obviousness-type double patenting, as allegedly being unpatentable over claim 13 of Kubo et al. (U.S. Patent No. 6,597,456) in view of Natsuume et al. (A New High Heat Resistant, High Clarity, And High Humidity Resistant Polymer For Optical Uses, **Materials Research Society Symposium Proceedings**, Materials Research Society, Pittsburg, PA, U.S. vol. 150, April 25, 1989, pages 245-250, XP009007850).

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Claims 4-6 and 22-25 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Naya in view of Natsuume.

Claims 1-12, 15-18 and 22-25 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Malmqvist et al. (U.S. Patent No. 5,492,840) in view of Natsuume.

VII. ARGUMENT

A. Nonstatutory Obviousness-Type Double Patenting: Claims 1-6 and 14-18 are patentable over claim 13 of Kubo et al. (U.S. Patent No. 6,597,456) in view of Natsuume et al.

1. Natsuume et al.'s polyolefin polymer "Zeonex" does not remedy the deficiencies of Kubo et al. which concededly lacks a dielectric block composed of synthetic resin

The Examiner has rejected claims 1-6 and 14-18 on the ground of nonstatutory obviousness-type double patenting as allegedly being unpatentable over claim 13 of Kubo et al. (U.S. Patent No. 6,597,456) in view of Natsuume et al. (A New High Heat Resistant, High Clarity, And High Humidity Resistant Polymer For Optical Uses, **Materials Research Society Symposium Proceedings**, Materials Research Society, Pittsburg, PA, U.S. vol. 150, April 25, 1989, pages 245-250, XP009007850; hereinafter "Natsuume"). For at least the following reasons, Appellant traverses the rejection.

Claim 1 recites:

> A surface plasmon resonance measuring chip for use in a surface plasmon resonance measurement apparatus constituted of a light source for emitting a light beam; an optical system for making said light beam enter a dielectric block at various angles of incidence so that a condition for total internal reflection is satisfied at an interface between said dielectric block and said metal film; and photodetection means for detecting the intensity of said light beam satisfying total internal reflection at said interface to detect surface plasmon resonance; comprising:
>
> a dielectric block;
>
> a metal film, formed on a surface of said dielectric block, for placing a sample thereon;

wherein said dielectric block is formed as a single block that includes an entrance surface which said light beam enters, an exit surface from which said light beam emerges, and a surface on which said metal film is formed;

said metal film is united with said dielectric block; and

said dielectric block is formed from a synthetic resin in which, when said light beam is p-polarized outside said dielectric block and then strikes said interface, the intensity of an s-polarized component at said interface is 50% or less of the intensity of said light beam at said interface.

The Examiner conceded on page 3 in the Office Action dated January 11, 2005 that Kubo does not recite a dielectric block composed of a synthetic resin. However, the Examiner has relied upon Natsuume for disclosing a polyolefin polymer, Zeonex, for optical uses. As such, the Examiner alleges that it would have been obvious to one of ordinary skill I the art to use the polyolefin polymer material of Natsuume in the dielectric block of Kubo, and because the dielectric block of Kubo is allegedly composed of the same material as the dielectric block recited by claim 1, Kubo's dielectric block would also allegedly possess the same properties as the claimed dielectric block (page 3 of Office Action dated January 11, 2005).

However, as discussed in the Amendment filed on August 10, 2007, claim 1 recites a dielectric block but also requires the dielectric block to include certain structural characteristics, the structural characteristics are such that the s-polarization of light be limited in the dielectric block. Though this feature of the dielectric is described in functional terms, it is the structure of the block that results in the polarization characteristics as claimed. Therefore, the recitation should be given full consideration as a structural recitation.

The Examiner has alleged on page 4 of the Office Action dated November 5, 2007 that the Zeonex cycloolefin of Natsuume is the same material used in the instant invention and thus

will have the same properties. However, even though Natsuume discloses the polyolefin polymer Zeonex, the polarization properties and birefringence level of a dielectric ***are not dependent only on the material of the dielectric***, as shape and molding/processing conditions are also other factors which would determine the polarization properties and birefringence level of the dielectric.

Evidence of such factors effecting polarization properties and birefringence level were previously submitted in the submission under 37 C.F.R. § 1.114 filed on March 19, 2007. Appellant has cited sufficient evidence to rebut any purportedly inherent characteristics. Appellant's submission under 37 C.F.R. § 1.114 filed on March 19, 2007 clearly demonstrated that Natsuume clearly cannot meet the limitations as claimed. For example, Reference 3 (of the Rule 1.114 Submission) shows a cycloolefin polymer having a substantial amount of birefringence, indicated by the white portions. One skilled in the art would understand that birefringence corresponds to an area of dual refraction, which would cause a change in polarization. The amount of birefringence shown in Reference 3 is substantial. Thus, Appellant has provided the technical data as to why Natsuume does not include the limitations on s-polarizations as claimed by claim 1, and further limited in claims 2 and 3.

As non-limiting exemplary embodiments, the s-polarization may be limited by the ability of a particular material to suppress double refraction (birefringence), the shape of the block, and/or whether a weld is formed within the dielectric during formation of the of block. From these examples, it is clear that multiple structures can provide the s-polarization limitation.

Furthermore, even though Natsuume does disclose a polyolefin polymer Zeonex, Natsuume's Zeonex is not taught or suggested to be capable of having the same properties of the dielectric block as recited by claim 1. Natsuume's Zeonex is but one form of a polyolefin polymer, as Zeonex has many different resin grades, such as but not limited to Zeonex 250, Zeonex 280, Zeonex 280R, Zeonex 280S, Zeonex 330R, Zeonex 450, Zeonex 480, Zeonex 480R, Zeonex 480S, Zeonex 490, Zeonex 490K, Zeonex 690R, Zeonex E28R, Zeonex E48R, Zeonex RS420 and Zeonex RS820. As such, Natsuume's general disclosure of a polyolefin polymer Zeonex would not teach or suggest such a dielectric block with characteristics which are specifically recited by claim 1.

The Examiner's rejection fails to carefully consider the recited characteristics of the claim elements, and thus is clearly incorrect. With further regard to Claims 2-3, the Examiner cannot demonstrate that the s-polarization is limited to such extent as described by these dependent claims. Therefore, claims 1-3 are patentable for all the above reasons.

Claims 2-6 and 14-18 are also allowable by virtue of their dependence on claim 1.

B. 35 U.S.C. § 102(e): Claims 1-3 are patentable over Naya et al.

35 U.S.C. § 103(a): Claims 4-6 and 22-25 are patentable over Naya et al. in view of Natsuume et al.

The Examiner has rejected claims 1-3 under 35 U.S.C. § 102(e) as allegedly being anticipated by Naya et al. (U.S. Patent No. 6,611,367; "Naya"), and rejected claims 4-6 and 22-

25 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Naya in view of Natsuume. For at least the following reasons, Appellant traverses the rejection.

1. Neither Naya nor Natsuume, alone or in combination, teach or suggest the features of claim 1

The examiner alleges on pages 3-4 of the Office Action dated July 19. 2006 that:

> The instant claims only require a dielectric block. No specific dielectric material is recited in the claims, which suggests that any dielectric material can be used in the dielectric block. The polycarbonate material that supports the metal film in the surface plasmon resonance sensor of Naya et al is sufficient to anticipate the dielectric block of the instant invention since it is a synthetic resin and a dielectric material. The last 3 lines of claim 1, as well as claims 2-3, can be viewed as either functional limitations or possibly even an intended use. In terms of an intended use, note that claims 1-3 recite "**when** said light is p-polarized" which suggests that other types of light can be applied to the dielectric block and the intensity of the s-polarized light at the interface would be immaterial if p-polarized light is not applied. In terms of the polarization characteristics being a functional limitation, since claim 1 is not limited to any specific dielectric material but only that the dielectric material be a synthetic resin, the implication is that any dielectric material that is a synthetic resin would apparently have the claimed s-polarization characteristics, such as the polycarbonate used in Naya.

Appellant respectfully submits that the rejection should be withdrawn for similar reasons as discussed above.

Appellant submits that the Examiner's failure to show the s-polarization characteristics in the prior art renders the rejection improper. Appellant respectfully submits that the Examiner has not carried the burden of maintaining the rejections. The primary deficiency relates to the fact that the materials disclosed at least by Naya and Natsuume do not appear to expressly or

inherently include the limitation on s-polarization as claimed. Therefore claim 1 is patentable over Naya for analogous reasons set forth above. Claims 2-6 and 22-25 are patentable based on their dependency. Natsuume does not make for the deficiencies. Even though Natsuume teaches ZEONEX, its field of use relates to a geometric configuration that would not necessarily result in the s-polarization features as described by claim 1. Even if one were to assume that some s-polarization suppression would occur in synthetic resin materials, there is no basis to conclude that the s-polarization would achieve the levels as claimed.

Furthermore, because Reference 3 of Appellant's submission under 37 C.F.R. § 1.114 filed on March 19, 2007 shows that cycloolefin polymers would not inherently limit s-polarization as claimed, it is thus also true that synthetic resins generally (of which cycloolefin polymers is included) also would not inherently include such polarization characteristics. Thus, the polycarbonate of Naya also would not inherently include all features of Claim 1 or its dependent claims.

Claims 2-3 describe even a more restrictive aspect of s-polarization that are not inherent in the art of record.

Therefore, claims 2-6 and 22-25 are patentable based on their dependency on claim 1. Natsuume does not otherwise make up for the deficiencies of Naya.

C. 35 U.S.C. § 103(a): Claims 1-12, 15-18 and 22-25 are patentable over Malmqvist et al. in view of Natsuume et al.

The Examiner has rejected claims 1-12, 15-18 and 22-25 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Malmqvist et al. (U.S. Patent No. 5,492,840; "Malmqvist") in view of Natsuume. For at least the following reasons, Appellant traverses the rejection.

1. Malmqvist in view of Natsuume does not teach of suggest the features of claim 1

> The examiner correctly concedes on page 6 of the Office Action dated October 18, 2005 that:
>
> Malmqvist et al differs from the instant invention in failing to teach using a cycloolefin polymer to support the thin metal film in the sensor unit.
>
> The Examiner, however, asserts that
>
> It would have been obvious to one of ordinary skill in the art to substitute a plate composed of the Zeonex cycloolefin polymer of Natsuume et al for the glass plate in the sensor unit of Malmqvist et al because the high transmittance properties of the Zeonex would provide for a more sensitive sensor unit

Appellant respectfully submits that the rejection should be withdrawn.

Appellant submits that this combination of Malmqvist and Natsuume includes the basic deficiencies as set forth above regarding the lack of the s-polarization characteristics as claimed.

Therefore, claims 2-12, 15-18 and 22-25 are patentable based on at least their dependency on claim 1 as well as for their additionally recited elements. Natsuume does not otherwise make up for the deficiencies of Malmqvist.

In view of the foregoing, Appellant submits that all the pending prior art rejections should be withdrawn.

The statutory fee of $510.00 is being charged to Deposit Account No. 19-4880 via EFS Payment Screen. The USPTO is also directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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Date: August 19, 2008

CLAIMS APPENDIX

CLAIMS 1-12, 14-18 and 22-25 ON APPEAL:

1. A surface plasmon resonance measuring chip for use in a surface plasmon resonance measurement apparatus constituted of a light source for emitting a light beam; an optical system for making said light beam enter a dielectric block at various angles of incidence so that a condition for total internal reflection is satisfied at an interface between said dielectric block and said metal film; and photodetection means for detecting the intensity of said light beam satisfying total internal reflection at said interface to detect surface plasmon resonance; comprising:

a dielectric block;

a metal film, formed on a surface of said dielectric block, for placing a sample thereon;

wherein said dielectric block is formed as a single block that includes an entrance surface which said light beam enters, an exit surface from which said light beam emerges, and a surface on which said metal film is formed;

said metal film is united with said dielectric block; and

said dielectric block is formed from a synthetic resin in which, when said light beam is p-polarized outside said dielectric block and then strikes said interface, the intensity of an s-polarized component at said interface is 50% or less of the intensity of said light beam at said interface.

2. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said dielectric block is formed from a synthetic resin in which, when said light beam is p-polarized outside said dielectric block and then strikes said interface, the intensity of a s-polarized component at said interface is 30% or less of the intensity of said light beam at said interface.

3. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said dielectric block is formed from a synthetic resin in which, when said light beam is p-polarized outside said dielectric block and then strikes said interface, the intensity of a s-polarized component at said interface is 10% or less of the intensity of said light beam at said interface.

4. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said synthetic resin is a synthetic resin that is selected from polymethylmethacrylate, a cycloolefin polymer, or a cycloolefin copolymer.

5. The surface plasmon resonance measuring chip as set forth in claim 2, wherein said synthetic resin is a synthetic resin that is selected from polymethylmethacrylate, a cycloolefin polymer, or a cycloolefin copolymer.

6. The surface plasmon resonance measuring chip as set forth in claim 3, wherein said synthetic resin is a synthetic resin that is selected from polymethylmethacrylate, a cycloolefin polymer, or a cycloolefin copolymer.

7. The surface plasmon resonance measuring chip as set forth in claim 1, wherein a sensing medium that exhibits a coupling reaction with a specific substance in said sample is fixed on said metal film.

8. The surface plasmon resonance measuring chip as set forth in claim 2, wherein a sensing medium that exhibits a coupling reaction with a specific substance in said sample is fixed on said metal film.

9. The surface plasmon resonance measuring chip as set forth in claim 3, wherein a sensing medium that exhibits a coupling reaction with a specific substance in said sample is fixed on said metal film.

10. The surface plasmon resonance measuring chip as set forth in claim 4, wherein a sensing medium that exhibits a coupling reaction with a specific substance in said sample is fixed on said metal film.

11. The surface plasmon resonance measuring chip as set forth in claim 4, wherein a sensing medium that exhibits a coupling reaction with a specific substance in said sample is fixed on said metal film.

12. The surface plasmon resonance measuring chip as set forth in claim 6, wherein a sensing medium that exhibits a coupling reaction with a specific substance in said sample is fixed on said metal film.

14. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said sample is fixed on said metal film and is held in a sample holding frame which is integrally formed on said dielectric block.

15. The surface plasmon resonance measuring chip as set forth in claim 1, wherein a top surface of said dielectric block is contiguous to said metal film such that there is substantially no air gap between said top surface of said dielectric block and said metal film.

16. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said dielectric block and said metal film are integrally formed.

17. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said dielectric block is formed in the shape of a rectangular parallelepiped.

18. The surface plasmon resonance measuring chip as set forth in claim 1, wherein said metal film comprises a vapor-deposited film.

22. The chip of claim 1, wherein the light source is configured to provide p-polarized light to the dielectric block.

23. The chip of claim 1, wherein said dielectric block is formed in a quadrangular pyramid shape.

24. The chip of claim 1, wherein the dielectric block is formed of an injected resin having no weld point at the entrance face.

25. The chip of claim 1, wherein the dielectric block is formed of an injected resin having limited dual refraction to limit the s-polarized light intensity.

EVIDENCE APPENDIX:

Pursuant to 37 C.F.R. § 41.37(c)(1)(ix), submitted herewith are copies of any evidence submitted pursuant to 37 C.F.R. §§ 1.130, 1.131, or 1.132 or any other evidence entered by the Examiner and relied upon by Appellant in the appeal.

References 1-8 as submitted with the Submission Under 37 C.F.R. § 1.114(c) of March 19, 2007.

RELATED PROCEEDINGS APPENDIX

Submitted herewith are copies of decisions rendered by a court or the Board in any proceeding identified about in Section II pursuant to 37 C.F.R. § 41.37(c)(1)(ii).

None.

表10　透明樹脂の屈折率温度変化率と熱膨張係数[10]

材料＼項目	屈折率温度変化率	熱膨張係数
PS	-130×10^{-6}／℃	80×10^{-6}／℃
PMMA	-105×10^{-6}／℃	68×10^{-6}／℃
PC	-107×10^{-6}／℃	66×10^{-6}／℃
光学ガラス（BK7）	$1\sim2\times10^{-6}$／℃	9×10^{-6}／℃

大きい。

構成原子，分子の関係で本質的に困難と思われるが，技術者の英知により今後，透明樹脂の分子量分布，熱膨張係数，吸湿性などの制御技術が開発され，屈折率の信頼度の向上，温度変化率の低減が待望される。そうなると現状JISによる屈折率の測定が最小目盛0.001のアッベの屈折計の使用を規定していることも見直さなければならなくなる。

（4）複屈折率

複屈折は，入射する方向により屈折率が異なる現象であり，場所による屈折率が異なる脈理と根本的に異なる。

複屈折は，透明樹脂中の電子の偏り，すなわち電子分極により発生するものでありローレンツ・ローレンツの式で表される材料組成により決定される。表11[10]に透明樹脂の固有複屈折率を例示する。非晶質樹脂では，構造自体に複屈折性（固有複屈折率）を有していても構造単位がランダムに配列している間は，お互いに打ち消しあい複屈折は観察されないが，成形・加工による分子配向に起因する配向複屈折，成形・加工の残留応力あるいは外部応力による応力複屈折として現れる。

表11　透明樹脂の固有複屈折率[10]

PS	−0.10
PPE	0.21
PC	0.106
PVC	0.027
PMMA	−0.0043
PET	0.105
PE	0.044

レンズにおける複屈折は，光線方向による結像点のずれを生じ鮮明な画像が得られなくなる欠点であるが，偏光を応用した液晶ディスプレイ（LCD）の位相差板（1/4 λ板）は，材料の複屈折性を積極的に利用したものであり，固有複屈折値が大きいＰＣが採用される。その場合も，固有複屈折値と延伸性能が安定していることが重要であることは言うまでもない。

以上のように，透明樹脂は光学ガラスと比較して種々の欠点を有しているが，それに優る非球面の実現容易性，軽量，安価，一体性形成などのメリットがあるのも事実であり，今後より一層の応用展開が期待される。

3.1.2　光学特性以外の物性

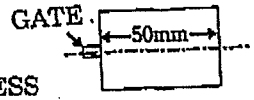
透明樹脂を使用する場合，単に光学特性を満足するだけでなくその他の特性をあわせて考えなければならない。透明樹脂の応用の観点で光学特性以外の特性について概説する。

Reference 2

光時代の透明性樹脂

SAMPLE SHAPE:

FLAT PLATE WITH 3mm THICKNESS



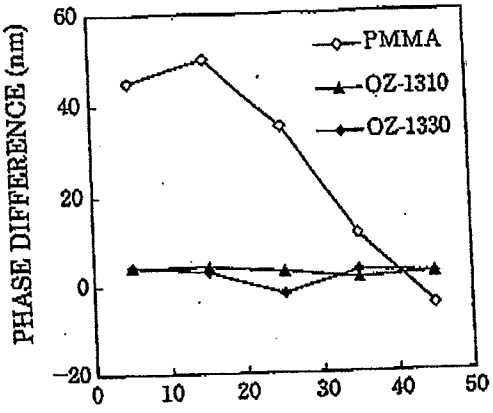


FIG. 3: BIREFRINGENCE OF PLATE FORMED BY INJECTION-MOLDING

非複屈折性樹脂（OZ-1300シリーズ）はゲート近傍から外縁部に至る全面において，複屈折がほとんど発生しない。

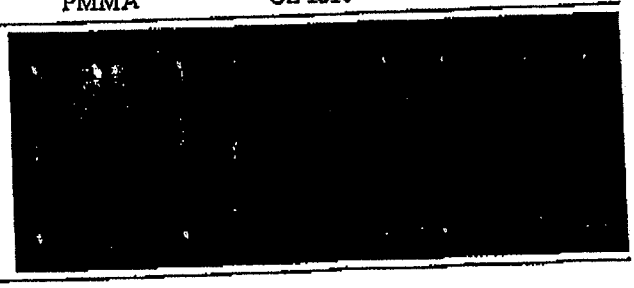
RESIN	PMMA	OZ-1310	OZ-1330
PLATE FORMED BY INJECTION-MOLDING (INJECTION-MOLDING PLATE)			
ORIENTATION BIREFRINGENCE Δn_{or} ($\times 10^{-5}$)	−10.2	<0.1	<0.1

FIG. 4: PHOTOGRAPH OF INJECTION-MOLDING PLATE PLACED IN POLARIMETER

OZ-1300シリーズの成形板には複屈折がほとんどないため，ゲート近傍まで均質な投影像が得られる。

Reference 3

表5　金型架体に要求される項目

要求特性項目			内容・目的	具体的方策
圧力容器			射出圧・保圧変形の対策	本体型厚，サポートブロック追加，型厚平行度
熱交換器			高速，均一冷却	高熱伝導型材，温度調節流路設計
高精度	ひけ		保圧充填の確保	ランナー設計，ゲート設計
	反り		固定型/可動型温度差の制御	高熱伝導型材，温度調節流路設計，光学的断熱
	捻れ（較型変形）		面内温度分布の低減	高熱伝導型材，温度調節流路設計，光学的断熱
	離型変形		無理な離型，張りつきの防止	突出し方式（コア突出し），突出しピン設計
	無　歪		流動原理，残留歪の対策	ゲート設計，温度調節流路設計
生産性	多数個取		射出，保圧，冷却，離型のキャビティ間バランス	ランナー方式，ゲート設計 温度分布，金型架体加工精度
	成形サイクル		高速充填 高速冷却	ランナー設計，ゲート設計 高熱伝導型材，温度調節流路設計
	稼働率・歩留り		安定動作	極力原理原則に則った簡素構造
コンタミフリー	錆レス		型内，外面の錆防止	金型材質，金型部品材質と表面処理
	オイルフリー		油分の染み出し防止	脱脂洗浄組立，固体潤滑
	摺動摩耗対策		可動摺動部分の摩耗対策	加工精度，固体潤滑
経済性	成形材料使用量		スプルー，ランナーの縮小	スプールランナーレス（ホットランナー），極小化設計
	金型コスト	金型材質	精度，生産性，コンタミフリーの総合判断	精度，不錆性を重視，熱伝導率を犠牲にして SUS系の選択が好ましい
		取付方式	直付け，スリーブ方式，スタンパー方式	レンズの大きさ，突出し方式，生産数（メンテナンス回数）から総合判断
		メンテナンスフリー	変形，かじり，傷，錆の防止	適正型構造，部品加工精度表面処理
		金型寿命	メンテナンスフリーに同じ	メンテナンスフリー項目，型材質（焼入れ）

4.3.2　成形技術

(1) プラスチックレンズに適用される成形法

プラスチックレンズの成形には，射出成形（レンズ一般），注型（メガネレンズ，コンタクトレンズ），熱プレス（フレネルレンズなど板状），押出し（レンチキュラーシート）など各種成形法が採用される。プラスチックレンズの成形に採用される成形法をまとめて表6に示す。いずれの方法であっても要求される項目は，精度，光学歪と生産性である。

高精度と低歪を実現するために金型（鋳型，口金），成形機，成形条件は勿論のこと金型温度制御装置，材料の安定化の材料乾燥装置，温度槽，材料安定供給装置などの設備とその使用条件の整備が不可欠である。熱可塑性プラスチックの加熱溶融，冷却固化，熱硬化樹脂の熱重合のようにプラスチックレンズ成形の基本は，熱（温度）である。特に射出成形の金型温度，注型の加熱槽温度の厳密な制御なくして高精度レンズの成形はあり得ない。

(2) 超精密射出成形

プラスチックレンズの製造で最も多く使用される射出成形は，主要工程（樹脂の加熱溶融，可塑化射出充填，冷却固化）が，シリンダー，金型内での現象であり，外部から直接観察が困難で

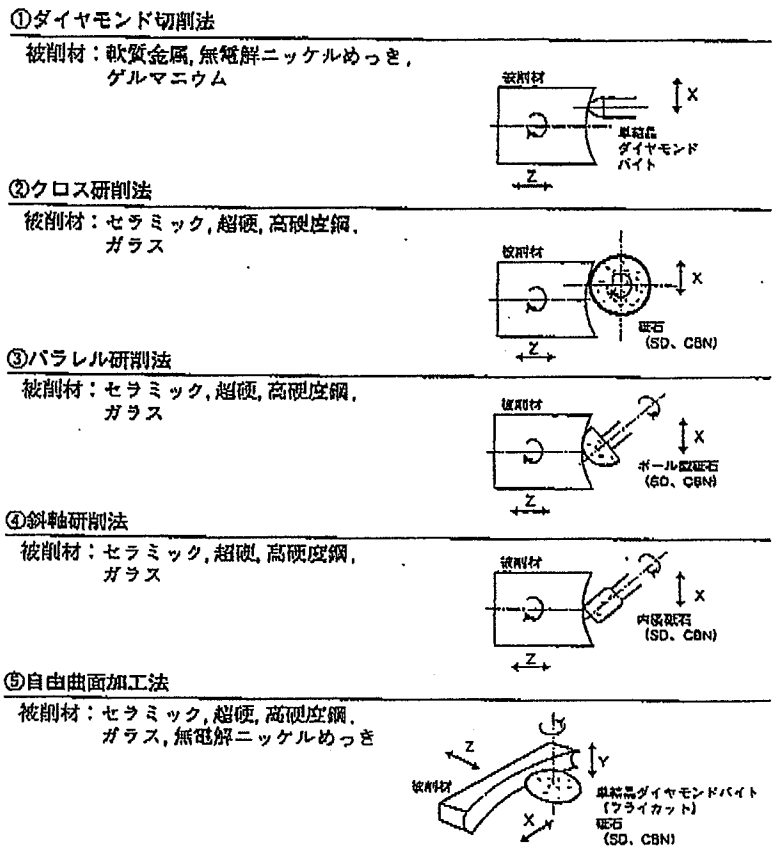


図10　光学部の精密加工法[10]

あることから，「密室殺人事件」と比喩されることがある。これを解決するためにシミュレーション，シリンダーおよび金型内の可視化[13]，樹脂流動温度，圧力の測定技術[14]の研究が進められている。

射出成形における主たる精度劣化は，射出・保圧・冷却工程で発生するひけ，反り・捻れ（鞍型変形）である。レンズ成形では，突出し機構の場所・大きさの制限から，離型時に変形させやすい。反り，捻れ，離型変形が肉厚変化（レンズのパワー変化）を伴わないのと異なり，ひけは，肉厚の変化を伴う致命的な欠陥である。射出成形に限らず，２P法，注型も含めて，ひけに着目したプラスチックレンズの高精度成形の体系を図11に示す。

ひけそのものの低減と成形のひけは許容する代わりに成形品には実害が現れないようにする安定成形指向に大別される。ひけの発生がPvT挙動，厚肉，肉厚方向の温度分布に起因することか

表6　プラスチックに適用される成形法の一覧

前項に記述したZEONEXと同様にノルボルネン構造は、嵩高い構造であり、これが材料を非晶性とし透明性に優れたものにしている。また、射出，押出しなどの通常の成形法において成形する際に生じる材料の配向に基づく歪みも、この嵩高い構造のため抑制され発生し難くなっている。また、ノルボルネン構造は環構造であるため、ある程度の耐熱性を付与する効果も有している。

このノルボルネン構造に加えて、Artonは構造中に極性基をもっていることが大きな特徴である。このため分子凝集力が高まり、無機や有機の多くの物質との親和性が向上している。

親和性の向上は実用上極めて重要な特徴である。例えば、透明基材の上に機能を付与することはよく行われており、光ディスクの場合においても反射膜，記録膜がスパッタリングや真空蒸着で付着されている。光学用プラスチックレンズにおいても、反射防止膜がレンズの表面にコートされる。また、傷付き防止のため、ハードコート材を表面に塗布硬化させることもよく行われる。Artonは、これらの金属，非金属やその酸化物，ハードコート材などとの親和性が優れているので、これらの膜の密着性が良好であり、このような用途に応用できる。

また、透明基材には色付けして使用する例も多いが、色付けのための顔料や染料との混和性の良さもArtonの極性基の作用によるところが多い。このように着色が容易なことに加え、透明性が優れているため、得られた基材は鮮明色となる。

極性基を含むことに起因する一つの欠点は吸湿率が高まることである。しかし、Artonではノルボルネン構造の炭化水素の集合体に基づく低吸湿率と極性基に基づく吸湿性とをバランスさせ、多くの用途で実用上問題の少ないPCと同じレベルの吸湿性になるように設定されている。

このようにArtonは、他のノルボルネン系非晶性ポリオレフィンとは異なる特徴を有しており、ファンクショナルなノルボルネン系樹脂として位置付けることができる。

Artonの物性

表3.19にArtonの物性を示す。

Reference 7

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参考資料7

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